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B21D 28/06

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(56) Documents Cited
GB 2229956 A GB 0647575 A GB 0332076 A
US 4688415 A US 4536952 A US 4362078 A
US 4280426 A US 3988796 A US 3589221 A

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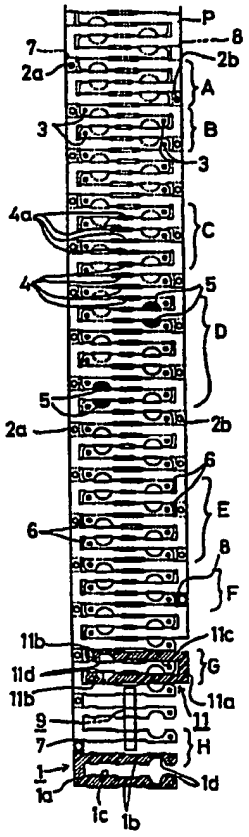
Online Databases : WPI, Claims

(54) Method of punching interlocking parts for stators

(57) It is an object of the present invention to improve the utilisation of material for minimising scrap and thus saving material cost and to eliminate the need for return punching and reverse punching for improved efficiency in punching and improved quality of the parts.

A plurality of U-shaped parts are punched from a hoop plate using a multistage progressive press apparatus. Comprising work stations A to H. On the hoop plate P, a pair of U-shaped stators 1, 11 which are to be punched are outlined in a face-to-face relationship so that one leg portion 11b of one stator 11 is inserted in a recess 1c of the other stator 11 and the visible outlines of the stators overlap with each other. Pilot holes 2a, 2b are formed in the hoop plate P in process A. The pilot holes are set within patterns 7, 8 for partial shape punching. In process C, a narrow slit 4 of a predetermined length is formed on the line at which the visible outlines of the stators 1, 11 overlap with each other. Processes D to F perform the punching of partial shapes 5, 6, 8 required for obtaining the shape of the part on the hoop plate. One stator 11 is punched off in process G and a partial shape 7 is punched in process H to punch off the stator 1. Figure 1.

FIG.1



GB 2 268 433 A

FIG. 1

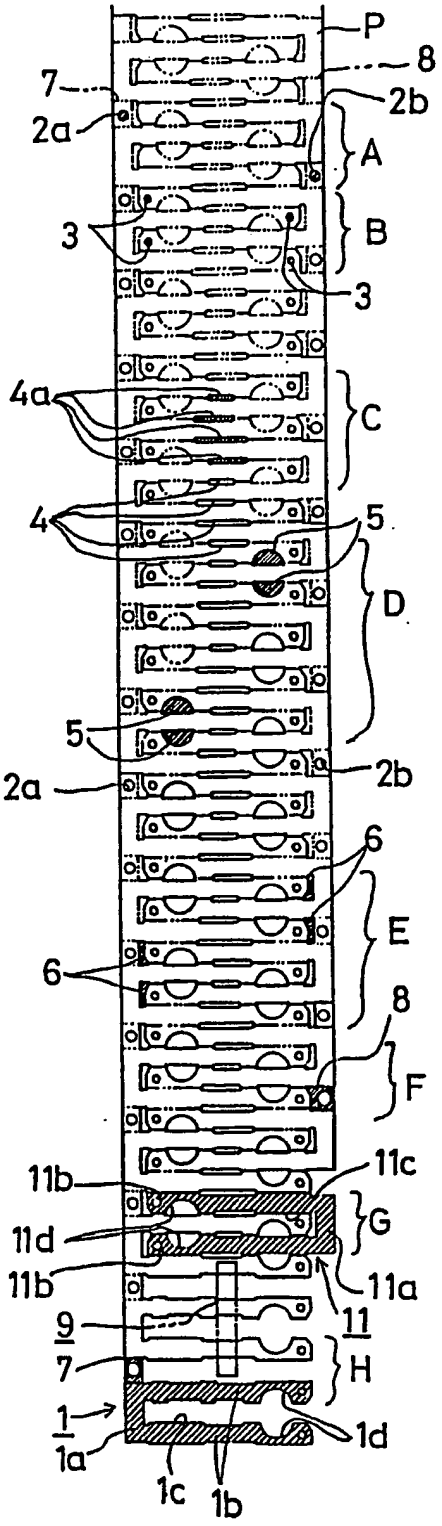
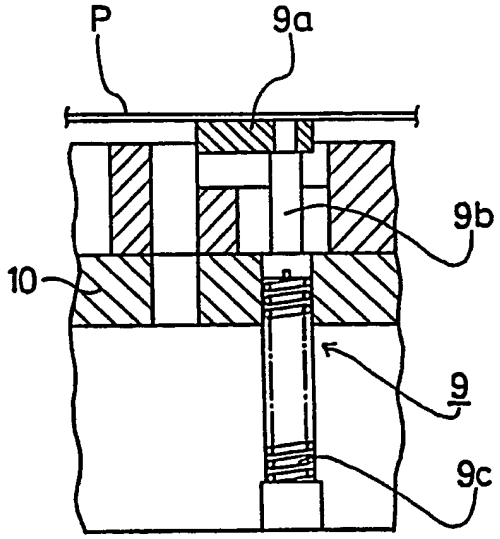

P
8
7
2b
2a
A
B
3
3
4a
C
4
5
D
5
2a
2b
6
E
6
8
F
11b
11c
G
11d
11b
11a
11
9
7
H
1
1a
1d
1c
1b

FIG. 2



METHOD OF PUNCHING PARTS

The present invention relates to a punching method for punching parts shaped such that they can be arranged so as to at least partially interlock. In particular, the present invention relates to a punching method for punching U-shaped parts, such as the stator used in a two-pole stepping motor for mechanical elements in, for example, a crystal clock.

There are various conventional ways of arranging blanks to be punched. Methods intended to improve the utilisation of material for minimising material cost include a scrapless method wherein blanks are arranged in adjoining relationship and are cut off from one end; a staggered multi-row method wherein blanks to be punched are staggered in multiple rows; an inclination method wherein blanks are arranged at an angle to save width, a rotary alternate method wherein blanks are arranged by rotating them in a 180-degree arc and are returned-punched, and a reverse alternate method wherein reversed blanks are alternately arranged and reverse punching is performed.

Each of the above-described methods has drawbacks. For example, the scrapless method is poor in terms of the precision of products; the staggered multi-row method is not suitable for short materials, and it requires complicated metal dies; the inclination method imposes many restrictions on the shape of blanks and, therefore, has a limited range of application; and the rotary alternate method and the reverse alternate method require return punching and reverse punching, respectively, which reduce efficiency and produce burrs and sags in opposite directions, deteriorating the quality of the parts.

The present invention therefore seeks to provide a punching method with improved utilisation of material, thereby reducing wastage as much as possible and saving

material cost, and which eliminates the need for return punching and reverse punching, thereby improving the efficiency of the punching operation and the quality of the parts.

According to one aspect of the present invention there is provided a method of punching out blanks, which are shaped such that they can be at least partially interlocked such that they have a common boundary, from a metal sheet using a progressive press apparatus, which has transfer means to sequentially move the metal sheet through the press to a plurality of pressing stages, wherein at each pressing stage the progressive press apparatus performs a pressing operation to at least partially punch out the blanks.

According to a second aspect of the present invention there is provided a method of punching U-shaped blanks wherein a plurality of U-shaped blanks are punched from a hoop plate using a multistage progressive press apparatus characterised in comprising a combination of processes of:

a) disposing a pair of blanks corresponding to the shape of said parts in a face-to-face relationship so that a part of one of the blanks will be inserted in a recess of the other blank and the visible outline of one of the blanks will overlap with the visible outline of the other blank;

b) forming a pilot hole in said hoop plate;

c) forming a narrow slit in a predetermined length along the line at which the visible outline of one of the blanks overlaps with the visible outline of the other blank;

d) performing partial shape punching of said hoop plate required for obtaining the shape of said part; and

e) punching out one of said pair of blanks and, thereafter, punching out the other blank.

The pilot hole can advantageously be formed within the overall extent of the material used for punching out the blanks but outside the extent of the U-shaped part, so avoiding leaving an unnecessary hole on the U-shaped part.

While one of the pair of blanks is transferred to a further punching station after the other blank has been punched out, the blank which is being transferred is supported by a support means on the lower surface thereof. A stable feed operation is thus effected.

Alternatively, prior to punching out one of the pair of blanks, all the partial punching necessary for both blanks may be completed, so that punching out one of the pair of blanks will cause the other blank to be punched out simultaneously. This is effective in reducing the number of process steps.

For a better understanding of the present invention, and to show how it may be brought into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a plan view of a hoop plate illustrating how a hoop plate is processed at each process step in the method according to an embodiment of the present invention; and

Figure 2 is a sectional view of a support means.

An embodiment of the present invention will now be described with reference to the drawings.

In Figure 1, U-shaped stator parts 1 and 11 for a small-sized motor are shown as examples of the shape of the parts that may be punched using the method of this invention. U-shaped stator parts 1 and 11 comprise two leg portions 1b and 11b, respectively, which extend in parallel from each end of base portions 1a and 11a, respectively. The gap between the leg portions 1b and the gap between the leg portions 11b constitute recesses 1c and 11c, respectively. Recesses 1c and 11c

are equal in width to the leg portions 1b,11b. At the tips of the leg portions, notches 1d and 11d, respectively, are provided to form magnetic pole portions for locating the rotor of the motor. The cutting outline for a pair of these U-shaped stators is arranged in an interlocking manner such that the leg portion 11b of the stator 11 is formed within the recess 1c constituting the gap between the leg portions 1b of the other stator 1. Base portions 1a and 11a are positioned on the left side and right sides, respectively, as shown in Figure 1. Such a cutting arrangement for the blanks makes it possible to perform punching of U-shaped stator parts from a hoop plate P having a width equal to the length of the leg portion of the stator part plus twice the width of the base portion of the stator part with a minimal amount of material wasted. To form a stator for a motor a magnetic material such as a silicon steel plate or permalloy is used as the hoop plate P.

A multistage progressive press apparatus (not shown) is used as the punching device. It is equipped with a means for transporting the hoop plate P progressively in the direction towards the bottom of Figure 1. The multistage progressive press apparatus is equipped with a press device, disposed at each of the processing stations A to H, each press device comprising a stationary die and a movable die corresponding to the shape to be punched.

In Figure 1, lines which have been punched in a previous process are indicated by solid lines and lines which are to be punched in later processes are indicated by two-dot chain lines. Furthermore pieces punched out at each of the processing stations A to H are indicated by oblique cross-hatching lines.

At a first processing station A, pilot holes 2a, 2b are punched out of the hoop plate P. The pilot

holes are guide holes which are used to transport the hoop plate P through the multi-stage progressive press apparatus, and are set outside the cutting line contour of the U-shaped parts. The pilot holes are located within patterns 7, 8 to be described later. The pilot holes 2a are positioned on the right hand side of the hoop plate P (viewed as in Figure 1) at predetermined intervals, and the pilot holes 2b are positioned on the left hand side of the hoop plate P (viewed as in Figure 1) at predetermined intervals.

At a second processing station B, circular holes 3 are punched through the hoop plate P at the tip of each of the leg portions 1b, 11b. Circular holes 3 constitute support holes for supporting the stators.

At a third processing station C, patterns 4a indicated by the oblique lines in Figure 1 are punched out on the line along which the stators 1 and 11 overlap with each other to form narrow slits 4 of a predetermined length. This pre-punching of patterns 4 reduces as much as possible the shearing stress produced when the stators are finally punched off. A large shearing stress is undesirable because it will cause transformation of the material, thus deteriorating the precision of the parts. Therefore, for parts which must be especially precise, it is desirable to reduce the punching resistance. The positions in which the slits 4 are formed are selected such that there is no adverse effect on the positional accuracy of punching when the notches 1d, 11d for rotors are punched, as is described later.

A fourth processing station D is designed to cover three pairs of stator parts at one time, and performs the punching of patterns 5 indicated by oblique lines forming notches 1d, 11d in positions separated from each other by one pair of stator parts. High precision is required for the punching of patterns 5 because this

operation constitutes the formation of the magnetic pole portions which are the hearts of the stators. Since the patterns 5 are punched in conditions equivalent to those in all punching operations using the press apparatus, no unevenness occurs in the striking force of the press die and, therefore, it is possible to achieve high positional accuracy. The formation of pre-punched notches also acts to reduce the shearing stress when the stators are finally punched off.

A fifth processing station E is designed to cover two pairs of stator parts at one time and performs the punching out of patterns 6 indicated by the oblique lines, to achieve the partial punching of the tips of the leg portions 1b, 1b', 11b, 11b' located on the opposite sides of each pair.

A sixth processing station F performs the punching out of patterns 8 for partial punching between the base portions 11a and 11a of adjoining stators 11 on one side, e.g., the right hand side as viewed in Figure 1 of the hoop plate P. Pilot holes 2b punched by the first processing station A in the right hand side pattern 8 are also punched out at this station. However, since patterns 7 for the left hand side pilot holes 2a are not punched out yet, the hoop plate P can be transported to the next station using the left hand side pilot holes 2a.

A seventh processing station G performs the punching of the remaining outline of the stators 11 having base portions 11a located on the right hand side as viewed in Figure 1, and the stators 11 are received by a parts receiver through a chute (not shown).

This final punching of the remaining outline of the stators 11 causes the outline of the stators 1 having base portions 1a located on the left hand side to be punched out as well, except for the pattern 7 on

the hand left side wherein the pilot holes 2a are formed. Since the patterns 7 keep the stators 1 contiguous, the stators 1 are transported to the next station using the left hand side pilot holes 2a.

The tip of the leg portion 1b of each stator 1 can now be regarded as the free end of a cantilever. In order to obtain stable support for the stator, a support means 9 (shown in Figure 2) is provided. Specifically, a long support plate 9a is disposed in the transporting direction so that it extends substantially across the middle of the leg portions 1b in contact with the lower surfaces of the stators 1. The support plate 9a is secured to the upper end of a shaft 9b which extends through a die 10 of the press apparatus, the lower end of the shaft 9b being received by a spring 9c. Therefore, the support plate 9a is always urged upward by a spring force and can move up and down in accordance with the punching operation.

An eighth processing station H performs the punching out of the patterns 7 between the adjoining base portions 1a located on the left hand side as viewed in Figure 1. As a result, the stators 1 are punched out and are received by a parts receiver through a chute (not shown).

The punching out of the stators 1 and 11 is now complete.

The order of the punching of the pilot holes, circular holes, slits, partial shapes, visible outlines and the like is not limited to the punching order at the processing stations as described above, but can be appropriately combined. Further, the present invention is not limited as to how many pairs of stators are covered by the width of each station.

Further, in the above-described example, the pattern 7 located on the left side is punched out last, so that one stator 1 of a pair of stators is punched

out after the other stator 11 is punched out. However, the present invention is not limited thereto, and the pattern 7 located on the left hand side may be punched out before the stator 11 is punched out so that the other stator 1 is punched out simultaneously with the punching out of the stator 11.

The positions of the pilot holes are not limited to those set within the patterns for partial punching described herein, but may be set in appropriate places.

As described above, according to the method of punching U-shaped parts of the present invention, a part of one blank is inserted in a recess of the other blank so that the visible outlines of the blanks will overlap with each other. This prevents waste of material, improving the utilisation of material, reducing material cost, and thus allowing a reduction in the costs of the parts. The punching of the pilot holes, the punching of the narrow slits, the partial shape punching, and punching out of the blanks are performed with a multistage progressive press apparatus without the need for return punching and reverse punching. This allows efficient processing and provides uniform quality because the punching operations are performed in the same direction. In addition, the shearing stress at the final punching out of the blanks is reduced in order to improve the precision of the parts.

Positioning the pilot holes within the pattern for partial shape punching eliminates unnecessary holes in the parts and the waste of the material which otherwise occurs when they are provided in positions other than in the material used to make the parts.

One of the blanks can be stably transported even after the other blank is punched out by supporting it with the support means.

By punching out a pair of blanks simultaneously,

the number of process steps can be reduced and processing time can be shortened.

CLAIMS

1. A method of punching out blanks, which are shaped such that they can be at least partially interlocked such that they have a common boundary, from a metal sheet using a progressive press apparatus, which has transfer means to sequentially move the metal sheet through the press to a plurality of pressing stages, wherein at each pressing stage the progressive press apparatus performs a pressing operation to at least partially punch out the blanks.

2. A method of punching our blanks as claimed in claim 1 wherein at at least one pressing stage a narrow slit is pressed in a predetermined length of the common boundary of two adjacent blanks.

3. A method of punching out blanks as claimed in any preceding claim wherein at each pressing stage the progressive press apparatus operates in the same direction.

4. A method of punching out blanks as claimed in any preceding claim wherein the transfer means interacts with a pilot hole punched out of the metal sheet by the progressive press apparatus in an initial step.

5. A method of punching U-shaped blanks wherein a plurality of U-shaped blanks are punched from a hoop plate using a multistage progressive press apparatus characterised in comprising a combination of processes of:

a) disposing a pair of blanks corresponding to the shape of said parts in a face-to-face relationship so that a part of one of the blanks will be inserted in a recess of the other blank and the visible outline of one of the blanks will overlap with the visible outline of the other blank;

b) forming a pilot hole in said hoop plate;

c) forming a narrow slit in a predetermined

length along the line at which the visible outline of one of the blanks overlaps with the visible outline of the other blank;

d) performing partial shape punching of said hoop plate required for obtaining the shape of said part; and

e) punching out one of said pair of blanks and, thereafter, punching out the other blank.

6. A method of punching blanks according to claim 4 or 5 characterised in that the position in which said pilot hole is formed is set within the pattern of a partial punching.

7. A method of punching blanks according to any preceding claim characterised in that when one of said pair of blanks is transferred to a punching station for it after the other blank is punched out, said one of the blanks is supported by a support means on the lower surface thereof.

8. A method of punching blanks according to one of claims 1-6 characterised in that prior to punching out one of a pair of blanks, all the partial shape punching corresponding to the both blanks are completed, so that punching out one of said pair of blanks will cause the other blank to be punched out simultaneously.

9. A method of punching blanks substantially as herein described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under section 17 (The Search Report)

Application number
GB 9313766.9

Relevant Technical fields

(i) UK Cl (Edition L) B3W

(ii) Int Cl (Edition 5) B21D

Search Examiner
A R MARTIN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI, CLAIMS

Date of Search
18 AUGUST 1993

Documents considered relevant following a search in respect of claims ALL CLAIMS

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	US 4688415 (USM) - see Figure 3	Claims 1 and 5 at least
Y	US 4536952 (YUKU) - see Figure 6	Claims 1 and 5 at least
Y	US 4362078 (AKZUNU) - see Figure 129	Claims 1 and 5 at least
Y	US 4280426 (MOTOR WHEEL) - see Figure 2	Claims 1 and 5 at least
Y	US 3988796 (TRIANGLE) - see Figure 3	Claims 1 and 5 at least
Y	US 3589221 (INLAND STEEL)	Claims 1 and 5 at least
Y	GB 2229956 (BORE STEEL) - see Claim 1	Claims 1 and 5 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9313766.9

Relevant Technical fields

(i) UK Cl (Edition) Contd. from page 2

(ii) Int Cl (Edition)

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner
A R MARTIN

Date of Search
18 AUGUST 1993

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 647575 (ENGLISH ELECTRIC) - see Figure 4	Claims 1 and 5 at least
Y	GB 332076 (HUMPHRIS) - see Figure 2	Claims 1 and 5 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

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